

(2) (JOISS)

2023-04-06

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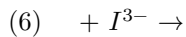
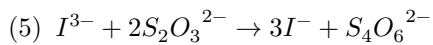
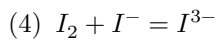
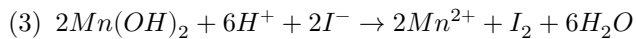
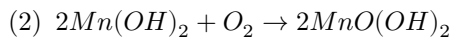
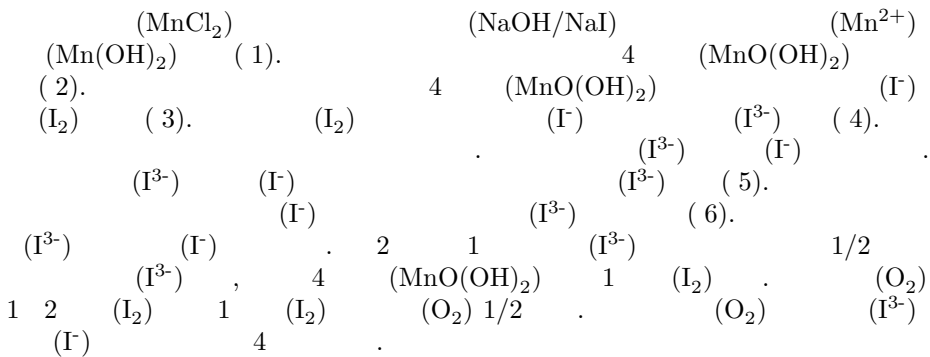
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Chapter 1

Winkler(1888) (Γ) (Γ^3) (Γ^3) $(2013-230)$
, , .

Chapter 2



0-400 mol kg⁻¹ . 0.1% ±0.3 mol kg⁻¹ .

Chapter 3

Chapter 4

(4.1), (4.2) . 10% 3 .

4.1

4.1.1

125 ml Pyrex .
 ± 0.003 ml .

4.1.2 /

3 . 1(MnCl₂), 2(NaI/NaOH), 3(Sulphuric Acid) 3 1.0 ml ± 0.02
 ml . 2(NaI/NaOH) , / .
 . 1(MnCl₂) 2(NaI/NaOH)

4.1.3

(Niskin bottle) (Tygon tube) .
 Tygon tube .

4.1.4

0.1 oC .
 mol L⁻¹ mol kg⁻¹ .

4.1.5

300g 0.001g .

4.2

4.2.1

， ， 。

4.2.2

1 ml, 2 ml, 5 ml 。

.(; Metrohm 665 Dosimat burette, SCHOTT Instruments TITRONIC universal)

4.2.3

(KIO₃) 1.0 ml 10.0 ml 。 SOCOREX

Calibrex 520 bottle-top 。 1-11 ml 0.25 ml 。

±0.002-0.005 ml 。 MetrohmTM 。

4.2.4

25mm 。

4.2.5

250 ml 。

Chapter 5

(5.1), (5.2), (5.3), (5.4), (5.5). (5.6) .

5.1 3M (MnCl₂ · 4H₂O)

(MnCl₂ · 4H₂O) 600 g 500-700 ml 1000
mL .
1000 ml . (,) . (MnSO₄ · 4H₂O) 480 g

5.2 (NaI/NaOH)

(NaOH) 320 g 500 ml .
(NaI) 600 g . (NaN₃) 10
g . 1000 ml .
(,) .

5.3 50% (v/v) (H₂SO₄)

(H₂SO₄) 50 mL 1:1 (50 ml 50 ml) .
50 ml . 100 mL . (,) .
,

5.4 1%

1 g 50 mL 100 mL .
1 , (Hg₂I₂) .

5.5 0.025 N (Na₂S₂O₃ · 5H₂O)

$$\begin{array}{rcl} (\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}) & 6.205 \text{ g} & 1000 \text{ mL} \\ & \cdot & \cdot \\ & 2 \text{ ml} & \cdot \end{array} \quad 400 \text{ mol kg}^{-1}$$

$$4 \times (C_1 \times V_1) = C_2 \times V_2$$

$$\begin{array}{l} C_1 : [\text{O}_2] = 400 \mu\text{mol L}^{-1} \\ V_1 : (10\%) = 14 \text{ ml} \\ C_2 : [\text{Na}_2\text{S}_2\text{O}_3] \\ V_1 : (2 \text{ ml}) \\ 4:1 \quad (\text{O}_2) \quad 4 \quad \text{Na}_2\text{S}_2\text{O}_3 \end{array}$$

$$\begin{array}{l} [\text{Na}_2\text{S}_2\text{O}_3] = \frac{400 \mu\text{mol L}^{-1} \times 140 \text{ ml} \times 4}{2 \text{ ml}} \simeq 0.11 \text{ M} \\ [\text{Na}_2\text{S}_2\text{O}_3] = 400 * 10^{-6} * 140 * 4 / \text{Burette volume}(2 \text{ ml}) = 0.11 \text{ M} \end{array}$$

$$\begin{array}{rcl} (\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}) & 1 & 248.17 \text{ g} & 27.4 \text{ g} & 1000 \text{ ml} \\ (\text{Na}_2\text{S}_2\text{O}_3) & 1 & 158.09 \text{ g} & 17.4 \text{ g} & \cdot \\ & & 1 \text{ L} & & \cdot \end{array} \quad 2-5$$

5.6 0.001667 M (KIO₃, 0.0100 N)

$$\begin{array}{rcl} (\text{KIO}_3) & 0.5 \text{ g } 120^\circ\text{C} & 2 \\ \text{mL} & \cdot & \cdot \\ 0.3567 \text{ g} & \cdot & \cdot \end{array} \quad 0.3567 \text{ g} \quad 1000$$

$$M() = \frac{1L}{(214.0g)}$$

Chapter 6

6.1

Noble gases(aragon and zenon), O¹⁷, Oxygen, and pCO₂ CFCs, Helium,

6.2

- 1.
- 2. ()
- 3.
- 4. 45
- 5. 2-3
- 6. CTD 1 ml 1 ml 90
- 7. NaI/NaOH 2 ml
- 8.
- 9.
- 10. 30
- 11. 1 30 2

Chapter 7

7.1

1. .
2. (KIO₃) 1 ml .
3. 50 % 1ml .
4. NaI/NaOH 1ml .
5. MnCl₂ 1 ml .
6. .
7. . (V1) .
8. V1 V3 . (V2) .

7.2 () by Carpenter (1965) method

1. .
2. .
3. 10.0 ml (0.00167 M) .
4. 50% 1 ml .
5. (NaI/NaOH) 1 ml . (I⁻) (IO₃⁻)
(I₃⁻) (IO₃⁻ + 8I⁻ + 6H⁺ → 3I₃⁻ + 3H₂O).
6. 1 ml .
7. .
8. 1 ml . ± 0.03 ml .
(I₃⁻ + 2S₂O₃²⁻ → 3I⁻ + S₄O₆²⁻).
9. (IO₃⁻) 1 (S₂O₃²⁻) 6 . 0.3% , ml 1 Vstd .

$$C_{Na_2S_2O_3 \cdot 5H_2O} = \frac{C_{KIO_3} \times 10.0 \times 6}{V_{Na_2S_2O_3 \cdot 5H_2O}}$$

$$\begin{aligned} C_{Na_2S_2O_3 \cdot 5H_2O} : Na_2S_2O_3 \cdot 5H_2O & \quad (\text{mole/L}) \\ C_{KIO_3} : KIO_3 & \quad (\text{mole/L}) \\ V_{Na_2S_2O_3 \cdot 5H_2O} : Na_2S_2O_3 \cdot 5H_2O & \quad (\text{mL}) \end{aligned}$$

7.3 (Standard-curve)

- 1. (KIO₃) 2, 4, 6, 8, 10 ml 5 .
- 2. .

7.4

- 1. .
- 2. .
- 3. 50% 1 ml . 50% 1 ml . pH
- 4. (I₂) .
- 5. (t_L) . ml ul V_{sam} .
- 6. .

Chapter 8

8.1

$$V_{\text{blk}} = V_1 - V_2 \quad I_2 \quad .$$

$$V_{\text{blk}} = V_1 - (V_2 - (V_3 - 1)) = 2V_1 - V_2 - V_3$$

$$\begin{array}{ll} V_1: & \text{KIO}_3 \text{ 1 ml} \\ V_2: & \text{KIO}_3 \text{ 1 ml} \\ V_3: & \text{KIO}_3 \text{ 1 ml} \\ V_{\text{blk}} & \text{ml} . \end{array}$$

8.2 KIO₃

$$\text{KIO}_3 \quad (t_p) \quad 20^\circ\text{C} \quad \text{KIO}_3 \quad .$$

$$M(\text{KIO}_3, 20^\circ\text{C}) = \frac{m(\text{KIO}_3)/(213.995\text{g} \cdot \text{mol}^{-1})}{V_s} \times \frac{0.998206}{\rho_w(t_p)}$$

$$\begin{array}{ll} m(\text{KIO}_3) : & \text{KIO}_3 \\ V_s : \text{KIO}_3 & (t_p) \\ 213.995\text{g mol}^{-1} : \text{KIO}_3 & 1 \\ \rho_w(t_p) : & \\ V_s = V_s[1 + \alpha_V(t_L - 20)] & \\ \alpha_V(\text{Pyrex}) : & 9.75 \times 10^{-6} \text{ }^\circ\text{K}^{-1} \end{array}$$

8.3

$$(t_L) \quad .$$

$$M(Na_2S_2O_3, t_L) = \frac{6000 \times V(KIO_3, t_L) \times M(KIO_3, t_L)}{V_{std} - V_{blk}}$$

$$\begin{aligned} V(KIO_3, t_L) &= V(KIO_3, 20^\circ C) \times (1 + 9.75 \times 10^{-6}(t_L - 20)) \\ M(KIO_3, t_L) &= M(KIO_3, 20^\circ C) \times \frac{\rho_W(t_L)}{0.998206} \\ 6000 &= \frac{6 \text{ mol } Na_2S_2O_3}{1 \text{ mol } KIO_3} \times \frac{1000 \mu l}{1 \text{ ml}} \\ V_{std} &: KIO_3 \\ V_{blk} &: \text{ (reagent blank) } \quad \text{ml} \quad 1 \end{aligned}$$

8.4

$$(\quad + \quad O_2) \quad .$$

$$n(O_2) = (V_{sam} - V_{blk}) \times M(Na_2S_2O_3, t_L) \times \frac{1L}{10^6 \mu l} \times \frac{1 \text{ mol } O_2}{4 \text{ mol } Na_2S_2O_3}$$

$$C(O_2) = \frac{[n(O_2) - 7.6 \times 10^{-8}]}{m(sample)}$$

$$\begin{aligned} 7.6 \times 10^8 : \quad & (MnCl_2 + NaI/NaOH) \quad 2 \text{ ml} \quad (O_2) \\ m(sample) \quad & \text{(kg)} \quad . \\ m(sample) &= V(O_2, 20^\circ C) \times [1 + 9.75 \times 10^{-6}(t_s - 20)] - 2 \times \rho(t_s), S) \\ t_s & \\ 2 & \\ \rho_{SW} & \end{aligned}$$

Chapter 9

$$/ \quad (QA/QC)$$

$0.16 \pm 0.94 \text{ mol/L}$ $5 \text{ } 10$ 0.44 mol/L $\pm 0.1 \%$ $\pm 0.45 \text{ mol kg}^{-1}$ 1.78 mol/L CTD

Chapter 10